Summary of TEL2 Activities

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AD / APC

Tevatron Department Meeting
October 16, 2009

Goals

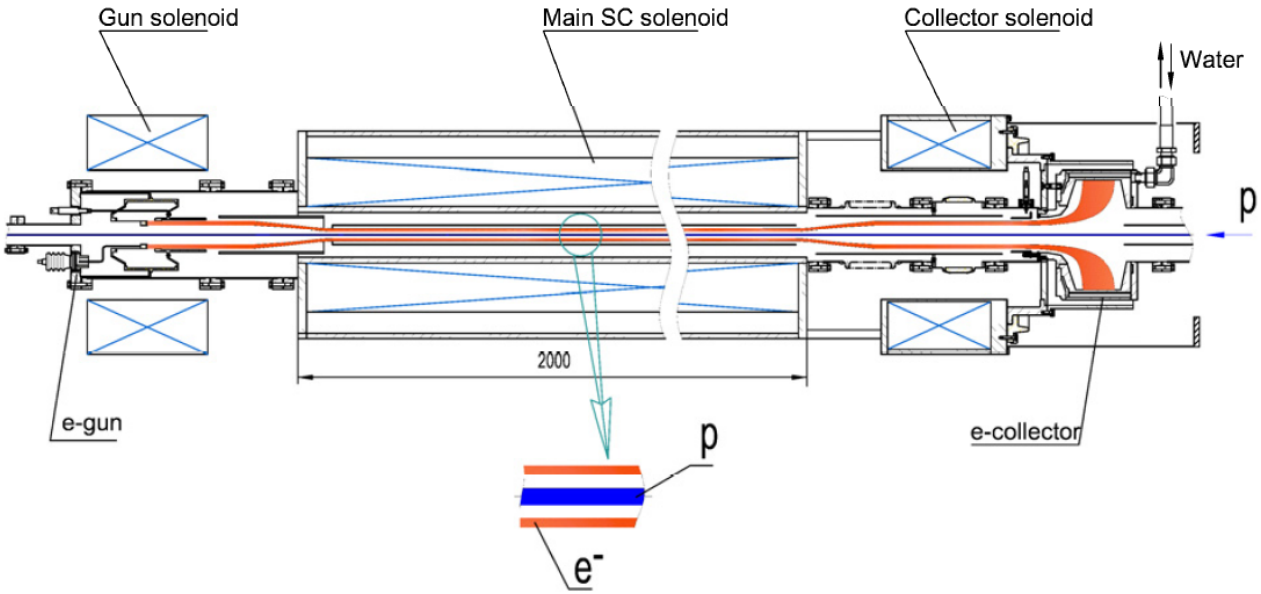
- Abort-gap clearing: verify that TEL2 with Gaussian gun is effective as backup for TEL1
- Beam-beam compensation: demonstrate effect of Gaussian gun on tune spreads
- Hollow-beam collimation: investigate new collimation scheme with hollow electron beams for Tevatron and LHC

Beam-beam compensation with Gaussian gun

- TEL2/Gaussian capable of changing tune spread by $\sim$0.01
- Bunch-by-bunch tune spread to be measured by exciting the beam with white noise around 21 kHz and detecting turn-by-turn BPM oscillation spectrum
- Diagnostics:
  - **hybrid box + oscilloscope + FFT**: 32k turns, 80 samples/bunch/turn at 8 GHz; tune-spread resolution is 2×10^{-5}; system is ready for use, but manual setup is time-consuming;
  - **digital tune meter**: integrated box, redesigned to increase dynamic range, work in progress (Instrumentation Dept.)
- Alignment of electron beam is critical

Hollow-beam collimation concept

- For halo scraping, electron beam can be placed closer to core ($\sim 4\sigma$) than conventional primary collimators (5σ in Tev, 6σ in LHC)
- Kicks are small, but not completely random



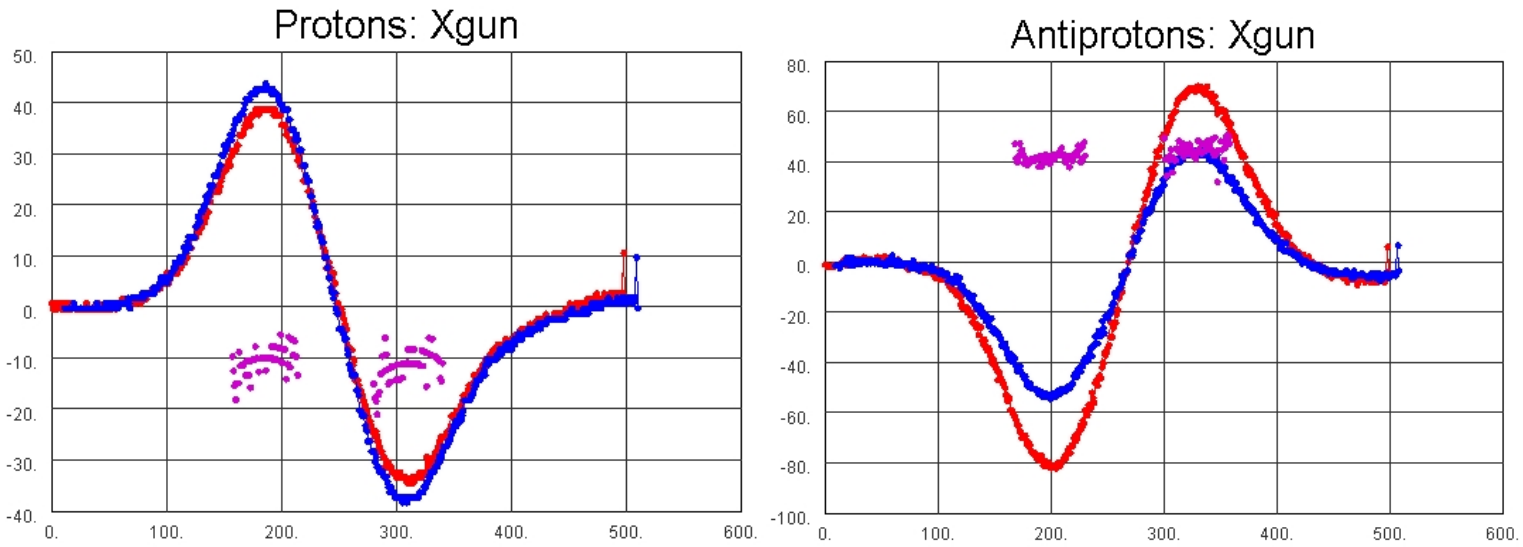
- 'Staged' collimation scheme: electrons $\rightarrow$ primary $\rightarrow$ secondary?
- Need to demonstrate (1) halo removal and (2) localized losses
- Proof of principle in Tevatron, LHC very interested

Recent activities

- Gaussian gun installed in TEL2 on 6/20, SEFT gun moved to linac test bench
- new TEL2 BPM Java-based readout
- designed hollow gun
- hollow gun produced by Hi-Tech Mfg using Heat Wave cathode, delivered on 8/27
- installed hollow gun in test bench, measurements under way
- timed electron beam, roughly aligned with proton bunches

New TEL2 BPM readout

- Measures proton, antiproton, and electron positions



- Can be timed to individual bunches
- Java-based, faster response than traditional Labview-based system

New TEL2 BPM Readout

- New devices (to be datalogged)

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T75  JAVA BPMS                          SET      D/A    A/D  Com-U ♦PTools♦
-<FTP>+ *SA♦ X-A/D   X=R:WALLJ   Y=R:BEAM   ,R SA0OUT,R:LMHSA ,R EMITHN
COMMAND ---- Eng-U   I= 15       I= 0       , 0       , 0       , 0
-< 5>+  One+ AUTO    F=-5        F= 12      , .8      , 10      , 60
general hivolt. modulat solnoid correct qpms    BPMS    support

-T:TL2GPX      TEL 2 Gun Horz Prot B -1.2439649   -1.2439649 mm
-T:TL2GPY      TEL 2 Gun Vert Prot B  4.9751101   4.9751101 mm
-T:TL2CPX      TEL 2 Col Horz Prot B -1.9428788   -1.9428788 mm
-T:TL2CPY      TEL 2 Col Vert Prot B  5.1136417   5.1136417 mm

-T:TL2GAX      TEL 2 Gun Horz Pbar B  4.0214591   4.0214591 mm
-T:TL2GAY      TEL 2 Gun Vert Pbar B -1.3181874   -1.3181874 mm
-T:TL2CAX      TEL 2 Col Horz Pbar B  2.8807416   2.8807416 mm
-T:TL2CAY      TEL 2 Col Vert Pbar B -1.1177005   -1.1177005 mm

-T:TL2GEX      TEL 2 Gun Horz Elec B  18.026546   18.026546 mm
-T:TL2GEY      TEL 2 Gun Vert Elec B -31.8256     -31.8256   mm
-T:TL2CEX      TEL 2 Col Horz Elec B  1000        1000       mm
-T:TL2CEY      TEL 2 Col Vert Elec B  2.4280531   2.4280531 mm
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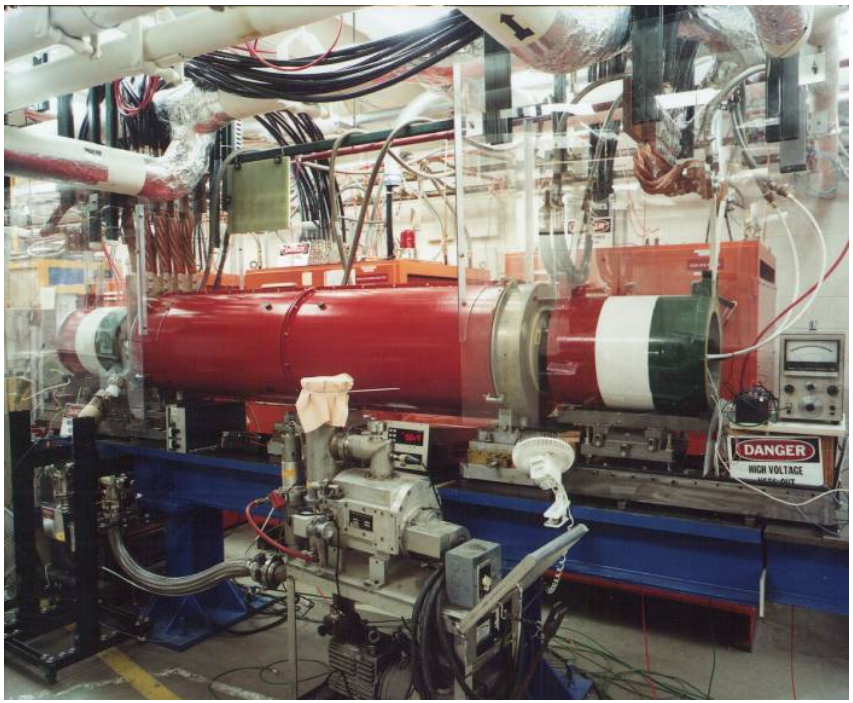
- Needs calibration:
  - protons — separators on/off during next wet squeeze
  - electrons — turn on in abort gap, change field in solenoids

Test bench in linac basement

- Built to develop TELs, now used to
  - characterize electron guns
  - study plasma columns for space-charge compensation

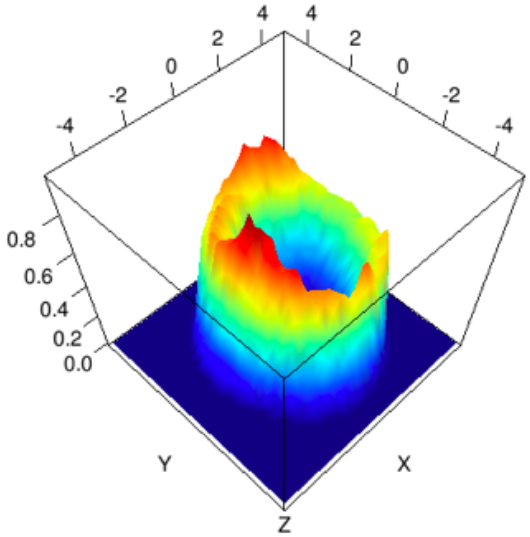


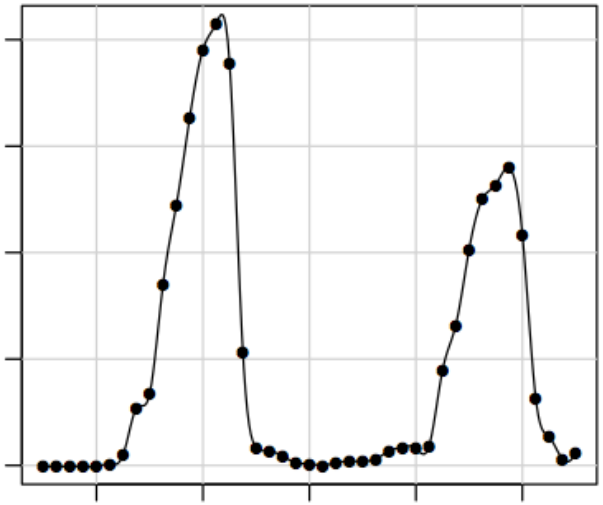
- High-perveance **electron guns**: few amps peak current at 10 kV, pulse width $\sim\mu$s, average current $<$2.5 mA
- Gun / main / collector **solenoids** ($<$4 kG) with magnetic correctors and BPM electrodes
- **Collector** with 0.2-mm pin-hole for profile measurements

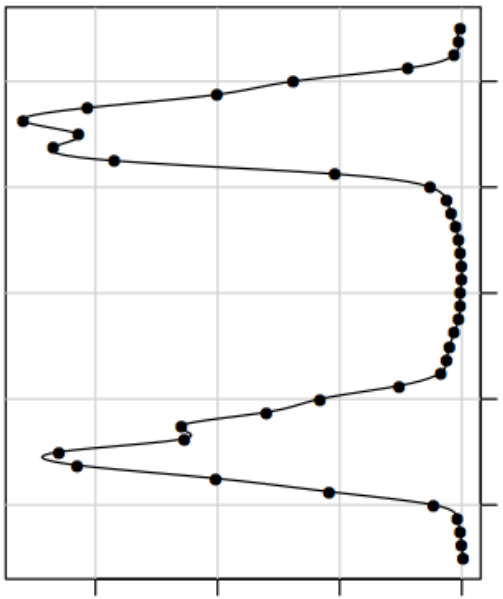
Measured hollow-gun profile — 6 kV

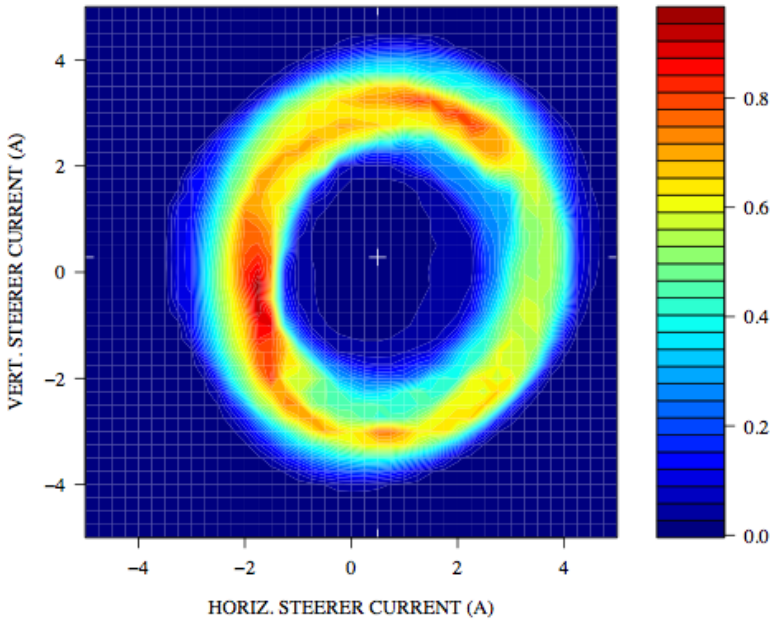
HOLLOW GUN
October 6, 2009

Vacuum: 2×10^{-8} mbar
Filament: 65 W (7.75 A)
Cathode voltage: -6 kV
HV PS current: 1.4 mA
Pulse width: 5 us
Rep. period: 16 ms
Peak current: 1.46 A
Solenoids: 3-2-3 kG





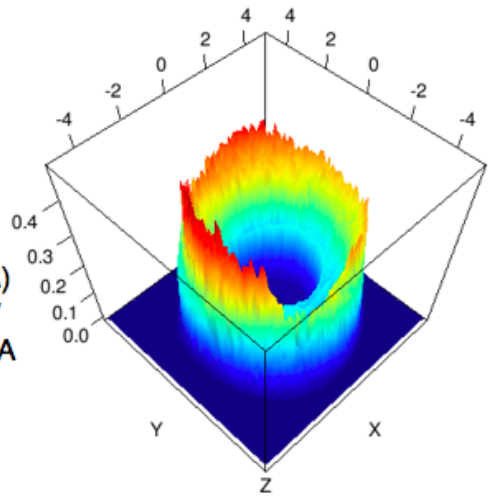


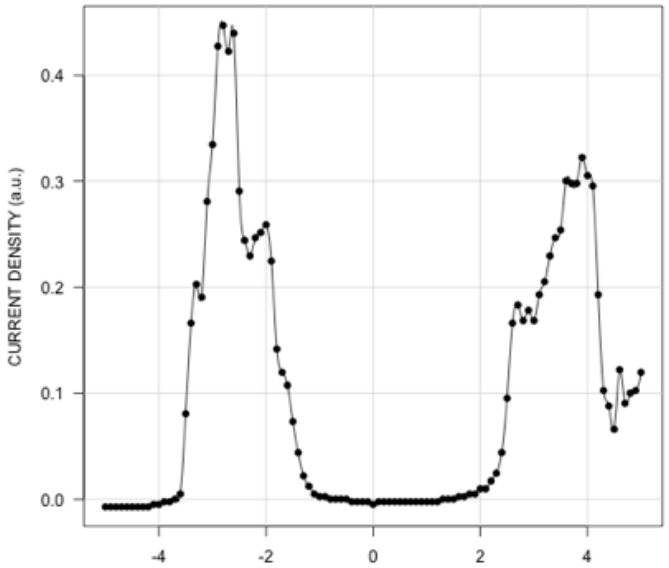


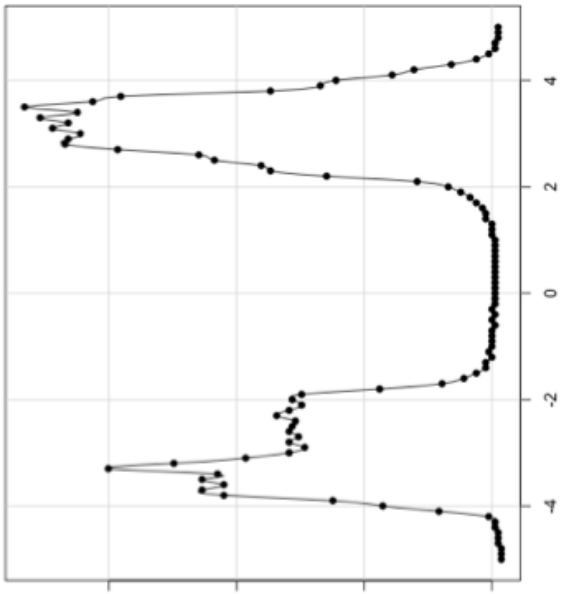
Measured hollow-gun profile — 9 kV

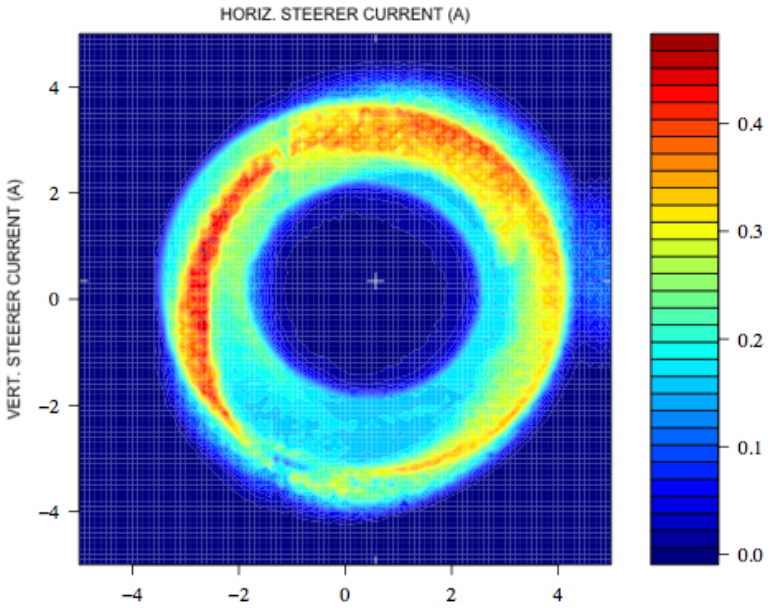
HOLLOW GUN
October 14, 2009

Vacuum: 2x10^{-8} mbar
Filament: 66 W (7.75 A)
Cathode voltage: -9 kV
HV PS current: 1.42 mA
Pulse width: 6 us
Rep. period: 80 ms
Peak current: 2.45 A
Solenoids: 3-2-3 kG









Next steps

- Calibrate BPMs with electrons and protons
- Align electron beam with protons
- Test abort-gap clearing
- Measure tune-spread changes due to Gaussian gun
- After this, install hollow gun in TEL2 when possible